

Approved modifications to the Residential Compliance Manual are noted below by section:

2008 RESIDENTIAL COMPLIANCE MANUAL

3 Building Envelope Requirements

3.3.2 Ceiling/Roof Insulation

Construction Practice

Ventilation

Where ceiling insulation is installed next to eave or soffit vents, a rigid baffle should be installed at the top plate to direct ventilation air up and over the ceiling insulation. See Figure 3-9. The baffle should extend beyond the height of the ceiling insulation and should have sufficient clearance between the baffle and roof deck at the top. There are a number of acceptable methods for maintaining ventilation air, including pre-formed baffles made of either paper or plastic. In some cases, plywood baffles are used.

The California Building Code (CBC) requires a minimum vent area to be provided in roofs with attics, including enclosed rafter roofs creating cathedral or vaulted ceilings. Check with the local building jurisdiction to determine which of the two CBC ventilation requirements are to be followed:

- CBC, Title 24, Part 2, Vol. 1, Section 1203.2 requires that the net free ventilating area shall not be less than 1/300 of the area of the space ventilated.
- CBC, Title 24, Part 2, Vol. 2.5, Section R806.2 requires that the net free ventilating area shall not be less than 1/150 of the area of the space ventilated. This ratio may be reduced to 1/300 if a ceiling vapor retarder is installed.

In either situation, a minimum of 50% of the vents must be located in the upper portion of the space being ventilated at least 3 feet above eave or cornice vents.

Ventilated openings are covered with corrosion resistant wire cloth screening or similar mesh material. When part of the vent area is blocked by meshes or louvers, the resulting "net free area" of the vent must be considered when meeting ventilation requirements.

Unvented Attic Assemblies

Attic ventilation is the traditional way of controlling temperature and moisture in an attic. In an unvented attic assembly insulation is applied directly at the roofline of the building, either above or below the structural roof sheathing. The roof system becomes part of the insulated building enclosure. For this case, the thermal boundary of the building results in an unconditioned attic space between the ceiling gypboard and the insulated roof above.

The provisions of CBC, Title 24, Part 2, Vol. 2.5, Section R806.4 describes conditions for insulation placed at the roof of the building as opposed to on top of the horizontal ceiling. Unvented attic assemblies are allowed provided that:

- Air-impermeable insulation is used below and in direct contact with the underside of the roof sheathing, or
- Air-permeable insulation is used below and in direct contact with the underside of the roof sheathing and rigid board or sheet insulation of at least R-4 is used above the roof sheathing, or
- Air-impermeable insulation is used below and in direct contact with the underside of the roof sheathing and an additional layer of air-permeable insulation is installed directly under the air-impermeable insulation.

Check with the local building jurisdiction to determine their specific requirements for unvented attic conditions.

Wood Rafter Constructions

Ventilating solid rafter spaces is more difficult than ventilating attics because each framing cavity requires its own vent openings. It is common practice with loose-fill mineral fiber and mineral wool, and cellulose insulation, for instance, to completely fill the cavity so that there is no ventilation at all. Also, if spray polyurethane foam (SPF) is used, it is applied to the underside of the roof deck leaving no ventilation space. With batt and loose-fill mineral fiber and wool insulation, it is possible to ventilate above the insulation using eave baffles, ridge vents, and careful installation.

3.3.7 Compliance Options

Quality Insulation Installation

Examples of poorly installed insulation are shown in Figure 3-19.

With the performance method, designers and contractors can get energy credit for correctly installing insulation to eliminate or reduce the problems described above. Reference Residential Appendix RA3.5 contains a procedure for verifying the quality of mineral fiber and wool, and cellulose insulation installation in low-rise residential buildings. Energy credit is also allowed for installing medium-density closed cell spray polyurethane foam (ccSPF) and low-density open cell spray polyurethane foam (ocSPF) in residential buildings. This energy credit is given for ccSPF when the required installation procedures described in Reference Joint Appendix JA7 are followed, or the alternative installation procedure may be followed that covers both ccSPF and ocSPF insulation-- *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell SPF*. Through the performance approach, a compliance credit is offered when this procedure is followed by the insulation installer and verified by a qualified HERS rater.

The procedure and credit apply to wood-framed construction with wall stud cavities, ceilings, floors, and roof assemblies insulated with mineral fiber, mineral wool or cellulose insulation in low-rise residential buildings. The procedures and credit for ccSPF and ocSPF apply to wood and metal-framed construction with wall stud cavities, ceilings, floors, and roof assemblies in low-rise residential buildings; those for ccSPF

also apply to nonresidential buildings but no energy credit can be taken. The ceiling/roof constructions are presented in Reference Joint Appendix JA4, Tables 4.2.1, 4.2.2, 4.2.5; the wall assemblies presented in Tables 4.3.1, 4.3.3 and 4.3.4; and the floor assemblies are presented in Tables 4.4.1, 4.4.2, 4.4.4 and 4.4.5..

The credit does not apply to other construction assemblies listed in Reference Joint Appendix JA4, including Structural Insulated Panels (SIPS), straw bale, or log construction.

Sprayed Wall Insulation

Sprayed wall insulation can be an effective way to deal with the irregularities of wall and ceiling cavities, especially the spaces around pipes, electric cables, junction boxes, and other equipment that is embedded in cavities. There are several types of sprayed insulation, including cellulose (see Figure 3-20), loose fill mineral fiber (fiberglass), mineral wool (rock wool), and spray polyurethane foam (SPF). Cellulose is basically paper that has been treated for flame- and insect-resistance. The product is similar to the loose fill cellulose that is commonly used in attic insulation retrofits, but for walls it is mixed with a water- and starch-based binder. The binder causes the insulation to stick to the surfaces of the wall cavity. Excess insulation that extends past the wall cavity is scraped off with a special tool and recycled into the hopper with the fresh insulation.

Loose fill fiberglass and mineral wool insulation

Loose fill fiberglass and mineral wool insulation is made up of small glass fibers. The product is similar to loose fill fiberglass or mineral wool material that is commonly used in attics, but for walls it can be installed behind a netting fabric or mixed with water based adhesive. The adhesive causes the insulation to adhere to surfaces of the wall cavity. Excess insulation that extends past the wall cavity is scraped off and recycled.

Spray Polyurethane Foam (SPF)

Spray polyurethane foam insulation is a foamed plastic formed by the combination of chemicals and a blowing agent applied using a spray gun. SPF insulation is spray applied to fully adhere to the joist and other framing faces to form a complete air seal within the construction cavities.

There are two types of SPF insulation: medium-density closed cell (ccSPF), and low-density open cell (ocSPF) insulation. They have different insulating properties, and compliance requirements as described below:

- ccSPF has been assigned an R-value of 5.8 per inch for compliance purposes and a nominal density of greater than 1.5 to less than 2.5 pounds per cubic foot (pcf).
- ocSPF has been assigned an R-value of 3.6 per inch for compliance purposes and a nominal density of 0.4 to 1.5 pounds per cubic foot (pcf).

ccSPF must be applied following the procedures detailed in Reference Joint Appendix JA7 or those of: *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell SPF*. The insulation shall be installed at the average thickness required to achieve the specified R-value of the assembly documented on the CF-1R. The installation thickness applied to meet these R-value levels shall be documented on the Installation Certificate (CF-6R). The nominal thickness of the SPF insulation shall be such that: (1) the average thickness shall be equal to or greater than that required to

meet the design R-value of the assembly, and (2) the minimum tested thickness shall be no more than ½ inch less than the required thickness for the R-value.

ccSPF is not required to fill the cavity. The insulation thickness shall be verified by using probes capable of penetrating the full thickness of the insulation with measurements marked by eighth inch increments. Measurements shall be accurate to within ±1/8 inch. The probes shall be used by HERS raters to verify that proper thickness of insulation has been applied.

A compliance credit for quality insulation installation (QII) is available for ccSPF insulation when the required procedures detailed in Reference Joint Appendix JA7 are followed or those of: *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Light-Density Open Cell SPF*. Installation must be verified by a qualified HERS rater. The energy credit only applies to low rise-residential buildings. The installation procedure and energy credit applies to wood or metal framed walls, ceilings, floors, and/or roof assemblies insulated with ccSPF insulation. Review Section 3.3.2 of this document, Appendix JA4, Section 4.1.7 of the Reference Appendices, or see Reference Residential Appendix RA3.5 for more discussion of Quality Insulation Installation (QII).

ocSPF insulation has an R-value of 3.6 per inch and a density of 0.4 to 1.5 pcf. ocSPF insulation is sprayed into the cavity then expands to fill the cavity. Excess insulation is removed with a special tool. When used for compliance, ocSPF is required to fill the cavity of 2x4 framing.

Measurement probes, gauges or devices shall be used by the HERS rater to verify that proper thickness of insulation has been applied. A pointed measurement probe or other gauge or device, capable of penetrating the full thickness of the insulation, shall be used having measurements marked by eighth inch increments. Insulation thickness measurement probes, gauges or devices shall be accurate to within ±1/8 inch.

A compliance credit for quality insulation installation (QII) is available for ocSPF insulation when the required procedures are followed detailed in: *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell SPF*. Installation must be verified by a qualified HERS rater. The energy credit applies to low rise-residential buildings. The procedure and credit applies to wood or metal framed walls, ceilings, floors, and/or roof assemblies insulated with ocSPF insulation. When ocSPF is being used as the building's air barrier system, specific requirements apply to the installed thickness of ocSPF. Review Section 3.3.2 of this document, Appendix JA4, Section 4.1.7 of the Reference Appendices, or the Reference Residential Appendix RA3.5 for more discussion of Quality Insulation Installation (QII).

The general method for calculating and using R-values and U-factors for SPF insulation is provided in *Reference Joint Appendix JA4, Section 4.1.7 and Tables 4.2.2, and 4.2.5* for roof/ceilings; *Tables 4.3.1, 4.3.3, 4.3.4* for walls, and *Tables 4.4.1, 4.4.2, 4.4.4 and 4.4.5* for floors. These apply to both wood or metal framed assemblies. The thermal performance of loose-fill mineral fiber and mineral wool, cellulose, and ocSPF is similar and one set of data is provided. In some cases, the data in Reference Joint Appendix JA4 assumes that the cavity of rafter roof constructions can be completely filled (no ventilation). Check with the building official in your area to verify that this method of insulation installation is acceptable.